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# The impact of global change on social behaviour of poison frog (Dendrobatoidea) : potential impacts and future challenges

**Shidagoud Patil**
Lecturer, Department Of Zoology
K.L.E's Raja Lakhamagouda Science Institute, Belagavi
***Corresponding Author* - Shidagoud Patil**
Email: shidu.patil97@gmail.com
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**Abstract**

Current effects and global changes complicate the interaction between animals (that is, social and sexual behaviours) and the environment in which they live. Amphibians are an ecologically diverse class with diverse social and sexual characteristics, providing an interesting model for understanding the potential adaptation of animals facing the effects of rapid environmental change caused by humans. Poison frogs (Dendrobatoidea) is a particularly interesting because it shows a variety of social behaviors that are the result of individual and environmental influences, thus providing a reference system to investigate how closely related species can respond to the effects of global change. Here, we discuss the potential effects of global changes in the behavior of poison frogs and the challenges this group may face in response to these changes. We focus on parental care and territorial specificity, a characteristic of this clade, and hypothesize that different species can respond and adapt flexibly to frequent and diverse anthropogenic stresses.

**Keywords**: Dendrobatoidea**,** Amphibian, Anuran, Tadpole, Habitat, climate change, evolution, herbicide, pesticide, metals, competition, predation, Deforestation, malformation, dysfunction, fertility, litter, phytotelmata, interspecific, communication, oviposition, abiotic, biotic, parasites, predators, host, community etc

## Introduction

Environmental changes, including climate change and habitat deterioration, have been shown to cause different responses in organisms across various taxa over evolutionary time. However, the unprecedented scale and speed of human and environmental changes, such as habitat destruction / fragmentation, climate change, and biotic (eg exotic species, pathogens, and parasites) and abiotic (eg; pollutants) stressors; presents new challenges for Many species that have not experienced changes as rapid as their evolutionary times and population.

For many animals, survival and reproduction in rapidly changing environments can be expected to depend on the plasticity of their behavioral responses. Sometimes, a change in behavior may be enough to allow it to adapt to a new situation, or it may provide additional time for genetic adaptation.

Although individual behavioral responses affect population dynamics at the local scale, the effects of global changes on communities and species-specific effects have ecological implications for community-wide dynamics. Environmental changes can directly and indirectly affect interactions not only with other species (eg predators and prey, hosts and parasites), but also with same species.

## Impacts of global change on poison frogs

Poison frogs depend on different micro-habitats at various life stages. For example, leaf litter and phytotelmata serve as the main breeding sites, refuges, and nurseries for poison frogs; in addition to the resources reserved for species in the area, they provide more stable temperature and humidity conditions than open areas with less cover. Dependence on the user's micro-habitat, requiring the use of a small body of water for reproduction or development, makes many frogs more vulnerable to global change.

## Habitat loss and climate change

Many tropical regions experience unprecedented habitat loss. Over the past

decade, deforestation in the Amazon rainforest, agricultural intensification from local deforestation, land use change, and exploitation of natural resources have geographically spread small-scale deforestation. Deforestation pressures are expected to affect areas and populations further afield. This type of rainforest is recognized as one of the main causes of frequent and severe anomalies in the hydrological cycle of the Amazon, extreme weather events and droughts during the rainy season, which can be exacerbated by global warming. Habitat loss and more frequent weather anomalies can affect archer frogs in different ways throughout their lifespan, leading to different behaviors and adaptations.

**Disruption of the communication system**

Habitat modification through small-scale deforestation can directly affect specific connectivity in two different ways. First, because man-made gaps experience higher levels of radiation and temperature than other areas of the forest, the calling behavior of men may not be stable in the long term. This is because in reduced conditions men will be more exposed and thus can cause loss of evaporation and overheating. This physiological stress has behavioral consequences because in the medium to long term, males are unable to spend time attracting females and advertising territorial ownership. Second, changes in the forest light environment can also change the animal's appearance, which is important in the courtship behavior of some bird species, and the color change pattern found in D. tinctorius has been shown to vary depending on the exposure. Differences in detection depending on the ambient light environment may be more important for species in which color patterns play a role, whether they are seen in open or closed cover, or whether it is mainly studied in the context of predator-prey interactions. It is the basis of differences in mate choice or other behaviors such as boldness or aggressiveness. Importantly, habitat disturbance managed by humans can affect not only the light environment, but also the structure of the forest floor, which can change the definition and visual contrast, thereby hindering peer communication.

Furthermore, because the coloring of poison frogs is based in part on dietary carotenoid pigments, changes in prey availability due to habitat disturbance can also change the color of individuals. In fact, some studies have shown that a diet rich in carotenoids can improve color changes and reproductive success in captive frogs. Thus, changes in prey availability can affect the uptake of carotenoids or their precursors and, in turn, affect interspecific communication, especially in species where, as mentioned above, color selection plays an important role.

**Implications for larval survival and possible evolutionary pathways in times of global change**

Changes in forest habitat for human land use and changes in climate patterns can change the availability and quality of critical resources and micro-habitats, affecting the poison frog during the larval and adult stages. For example, by clearing primary forest and reducing canopy cover, there is greater exposure to soil radiation, which increases soil temperature and threatens phytotelmata and drying. This is especially true given that the scarcity of certain resources (e.g. phytotelmata bromeliads) has been linked to serious population declines in several species of poison dart frog.

Phytotelmata are used in many species of ant frogs and can vary naturally with water availability, nutrient content, food source, stability, competition and predation risk. Consequently, parents must evaluate these various environmental factors, which are highly unstable and vary in space and time, and adapt their deposit strategies according to this information. Furthermore, the size of breeding pools is related to the evolution of parental care strategies. The selection of suitable nursing sites will play an important role in the successful development and survival of the offspring, thus directly affecting the recruitment of diverse populations. However, global changes can exacerbate the instability and availability of high-quality phytotelmata, leading to high costs of parental care and territoriality. Because these stresses can occur mainly in small phytotelmata, they can especially affect species with parental care strategies such as egg feeding. Importantly, nursery damage has been considered one of the most common abiotic causes of ant mortality, even in tropical rainforests with high annual rainfall.

**Infectious diseases and pollution**

In the Amazon rainforest, the rapid growth of agriculture, urbanization, and large-scale and small-scale mining activities,

especially gold mining, are not only changing the habitat, but also polluting the environment. In addition, the accidental or deliberate introduction of exotic species, especially the global pet trade involving poison dart frogs, increases transmission and susceptibility to pathogens and parasites in previously isolated populations.

Illegal mining. Deforestation due to illegal mining threatens the habitat of many poison dart frog species in the Amazon. The illegal pet trade is recognized as a major threat to dendrobatid poison dart frogs.

In addition, chemical pollutants from agriculture (eg; herbicides and pesticides) and mining (eg: metals and metalloids: Hg, Cu, Co, Zn and As) can damage the human immune defense system and increase susceptibility to pathogens and diseases. Likewise, if found in low concentrations, they can delay growth and metamorphosis, cause malformation, change fertility, or cause sexual dysfunction, often with devastating consequences for the amphibian population. A growing body of evidence shows effects on various amphibian traits, such as reduced activity (for example, swimming, feeding, and reproduction) or the ability of ants to escape predation, for example, exposure to sublethal concentrations of mercury reduces appetite. and impaired swimming performance in American toad larvae. Although chemical pollutants have been reported to change many social behaviors such as behavior in other taxa, no studies have addressed this possibility in amphibians. Given the strong harmful effects of pollutants on the survival and development of eggs and ants, we expect individuals to recognize and avoid oviposition and breeding sites based on the concentration of chemical contaminants. To our knowledge, this ability has been tested in some anurans, but not in poison frogs. For example, adult gray tree frog do not spawn in ponds if they are contaminated with glyphosate pesticides.

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